

We claim:

1. A method for generating or increasing the resistance, in plants, to at least one biotic or abiotic stress factor, comprising the following steps:
 - a) increasing the amount of protein, or the function, of at least one Bax inhibitor-1 (BI1) protein in at least one plant tissue with the proviso that the expression in the leaf epidermis remains essentially unchanged or is reduced, and
 - b) selection of the plants in which, in comparison with the starting plant, a resistance to at least one biotic or abiotic stress factor exists or is increased.
2. The method according to claim 1, wherein the stress factor is a plant pathogen.
3. The method according to claim 1 or 2, wherein the stress factor is a necrotrophic or hemibiotrophic pathogen.
4. The method according to any of claims 1 to 3, wherein the BI-1 protein comprises at least one sequence which has at least 50% homology with at least one BI1 consensus motif selected from the group consisting of
 - a) H(L/I)KXVY,
 - b) AXGA(Y/F)XH,
 - c) NIGG,
 - d) P(V/P)(Y/F)E(E/Q)(R/Q)KR,
 - e) (E/Q)G(A/S)S(V/I)GPL,
 - f) DP(S/G)(L/I)(I/L),
 - g) V(G/A)T(A/S)(L/I)AF(A/G)CF(S/T),
 - h) YL(Y/F)LGG,
 - i) L(L/V)SS(G/W)L(S/T)(I/M)L(L/M)W, and
 - j) DTGX(I/V)(I/V)E.
5. The method according to any of claims 1 to 4, wherein the BI-1 protein is encoded by a polypeptide comprising at least one sequence selected from the group consisting of:
 - a) the sequences as shown in SEQ ID NO: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32 and 38, and

- b) sequences which have at least 50% identity with one of the sequences as shown in SEQ ID NO: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32 and 38,
- 5 c) sequences which comprise at least one part-sequence of at least 10 contiguous amino acid residues of one of the sequences as shown in SEQ ID NO: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32 and 38.
- 10 6. The method according to any of claims 1 to 5, wherein the increase in the protein quantity or function of at least one BII protein is effected by recombinant expression of said BII protein under the control of a root-, tuber- or mesophyll-specific promoter.
- 15 7. The method according to any of claims 1 to 6, comprising the
- 20 (a) stable transformation of a plant cell with a recombinant expression cassette comprising a nucleic acid sequence coding for a BI protein in functional linkage with a tissue-specific promoter, the promoter having essentially no activity in the leaf epidermis and the promoter being heterologous with regard to said nucleic acid sequence which codes for the BI protein;
- 25 (b) regeneration of the plant from the plant cell; and
- 30 (c) expression of said nucleic acid sequence which codes for a BI protein in an amount and for a period sufficient to generate or to increase a stress and/or pathogen resistance in said plant.
- 35 8. The method according to any of claims 1 to 7, wherein the plant is selected from among the monocotyledonous and dicotyledonous plants.
- 40 9. The method according to any of claims 1 to 8, wherein the plant is selected from the group of the monocotyledonous plants consisting of wheat, oats, millet, barley, rye, maize, rice, buckwheat, sorghum, triticale, spelt, linseed and sugar cane.
- 45 10. The method according to any of claims 1 to 9, wherein the expression of the Bax inhibitor-1 (BI-1) in the mesophyll is increased.

11. The method according to any of claims 1 to 10, wherein the plant has an mlo-resistant phenotype, or the expression or function of MLO, RacB and/or NaOx is inhibited or, in comparison with a control plant, is reduced at least in the epidermis and/or the expression or function of PEN2, SNAP34 and/or PEN1 is increased at least in the epidermis in comparison with a control plant.
12. A polypeptide sequence coding for a BI1 protein comprising at least one sequence selected from the group consisting of
- a) the sequences as shown in SEQ ID NO: 12, 14, 16, 18, 20, 22, 24, 28, 30, 32 or 38,
 - b) sequences which have at least 90%, preferably at least 95%, especially preferably at least 98%, homology with one of the sequences as shown in SEQ ID NO: 12, 14, 16, 18, 20, 22, 24, 28, 30, 32 or 38, and
 - c) sequences which comprise at least 10, preferably at least 20, especially preferably at least 30, contiguous amino acids of one of the sequences as shown in SEQ ID NO: 12, 14, 16, 18, 20, 22, 24, 28, 30, 32 or 38.
13. A nucleic acid sequence coding for a polypeptide sequence according to claim 12.
14. A recombinant expression cassette comprising a nucleic acid sequence coding for a BI protein in functional linkage with a tissue-specific promoter, the promoter having essentially no activity in the leaf epidermis and the promoter being heterologous with regard to said nucleic acid sequence which codes for the BI protein.
15. The recombinant expression cassette according to claim 14, where
- a) the BI1 protein is as defined in any of claims 4, 5 or 11, and/or
 - b) the tissue-specific promoter is selected from the group of the root-, tuber- or mesophyll-specific promoters.

16. A recombinant vector comprising an expression cassette according to claim 14 or 15.
- 5 17. A recombinant organism comprising at least one expression cassette according to claim 14 or 15 and/or at least one vector according to claim 16.
- 10 18. The recombinant organism according to claim 17 selected from the group consisting of bacteria, yeasts, nonhuman animals and plants.
- 15 19. The recombinant organism according to claim 17 or 18, selected from the group of the plants consisting of wheat, oats, millet, barley, rye, maize, rice, buckwheat, sorghum, triticale, spelt, linseed, sugar cane, oilseed rape, cress, Arabidopsis, cabbage species, soybean, alfalfa, pea, beans, peanut, potato, tobacco, tomato, eggplant, paprika, sunflower, Tagetes, lettuce, Calendula, melon, pumpkin/squash and zucchini.
- 20 20. The recombinant organism according to any of claims 17 to 19, wherein the organism is a plant which additionally has an mlo-resistant phenotype.

Method for increasing the resistance to stress factors in plants

Abstract

- 5 The invention relates to methods for generating or increasing the resistance, in plants, to at least one biotic or abiotic stress factor, preferably to plant pathogens, by increasing the expression of at least one Bax inhibitor 1 (BI1) protein in at least one plant tissue, with the proviso that the expression in
- 10 the leaf epidermis remains essentially unchanged. The invention furthermore relates to recombinant expression cassettes and vectors which comprise a nucleic acid sequence coding for a BI protein under the control of a tissue-specific promoter, the promoter having essentially no activity in the leaf epidermis. The
- 15 invention furthermore relates to recombinant plants transformed with said expression cassettes or vectors, to cultures, parts or recombinant propagation material derived from these plants, and to the use of same for the production of foodstuffs, feeding stuffs, seed, pharmaceuticals or fine chemicals.